No. 2. The circulation about LOWS 1 and 3 would produce west winds at Los Angeles, opposing those of No. 2. Evidently there was a conflict of wind systems during the morning, one bringing cold air from the desert and the other warmer, moisture-laden air from the ocean. Surface wind vanes did not indicate any reversal of direction during the morning, but one of our photographs,

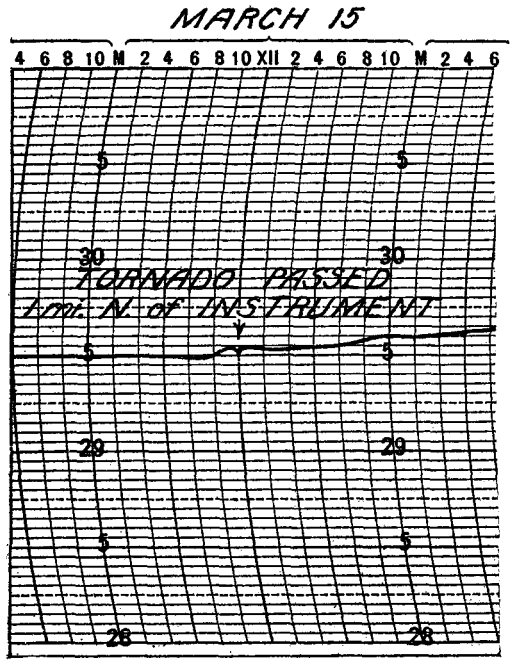


FIGURE 5.—Barograph record at Vernon, Calif., March 15

taken a few minutes after the tornado passed, showed in the cloud formation a pronounced movement upward and from west to east, as opposed to the surface wind from east to west. Apparently the tornado occurred on the wind-shift line. Perhaps the fact that surface winds did not shift was a factor in limiting the intensity of the surface whirl. The chief wind changes were aloft.

Wind and temperature conditions were conducive of upward currents, indicative of squalls and thunderstorms. The centers of all three LOWS were at very low pressures (29.4, 29.4, 29.5 inches), affording general cyclonic movements of considerable intensity.

Rain began at the Los Angeles Weather Bureau (Sixth and Main Streets) at 11:10 a. m., rain and hail at 11:23; hail stopped at 11:40, rain at 11:50. Lightning and thunder were observed. No rain or hail fell at Vernon during this time, although thunder was heard. The Vernon observations were made at a point 2.8 miles S. 33° E. from the Los Angeles Weather Bureau.

The tornado passed within a mile of the barograph at the department of tests in Vernon. Figure 5, the barograph curve showed only a weak pressure drop, indicating that the tornado was not a severe one, although the instrumental effects were of quite definite tornadic character. The barograph had been reading 29.50 inches of mercury during the rain of Friday afternoon and night and until 8:30 a. m. on Saturday. It rose slowly to 29.55 at 11 a. m. and held there until about the time of the storm, when it fell to 29.53 and then rose again to 29.55 by 12:15 p. m. The observed pressure drop of 0.02 inch, followed by an equal rise, was no greater than that due to a moving thunderstorm of the type well known in the Middle West and East. Air temperature and wind velocities were not measured at Vernon. The wind was estimated at less than 10 miles per hour outside the direct path of the tornado, where velocities of perhaps 40 or 50 miles were attained.

No rain fell in Vernon until about 3 p. m., after which intermittent rain with thunder continued until late in the evening.

REFERENCES

(1) Finley, Tornadoes, New York, 1887. Ferrel, A Popular Treatise of the Winds, New York, 1889. Although these books are old, they contain the detailed discussions of tornadoes which are the basis of standard works of the present day.
(2) Humphreys, Physics of the Air, Philadelphia, 1920.
(3) Milham, Meteorology, New York, 1925.
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## THE HARDTNER (KANS.) TORNADO OF JUNE 2, 1929[1]

By IRA B. BLACKSTOCK

The tornado at Hardtner, Kans., was observed under very favorable conditions of light about 4:30 p. m. Sunday, June 2, 1929, and was photographed at that time. (See fig. 1.) There was no scattering of débris during the storm or afterwards other than that caused by the contact of the funnel cloud with the earth as it passed across country.

The wind came from south or perhaps a little southwest of Hardtner and then from a northeasterly or perhaps more of an easterly direction. Large hail preceded the storm by several miles and there was a light rain and a very strong rumbling noise associated with the passing of the tornado. The temperature in the morning was was 75° at 9 o'clock, 90° at noon, and 95° at 3 p. m. There was a considerable fall in the temperature. The tornado cloud from which the funnel was pendent was of a dirty dark-brown color and extended about 10 miles east-west and 1½ miles north-south. There was practically no lightning. The top of the funnel was perhaps 2 city blocks or more wide and the bottom where it touched the ground did not seem to be over 150 feet wide.

The whirling of the funnel cloud was clearly visible from the top where it joined the main cloud all the way down to where it made contact with the earth.

Little damage was done perhaps due to the fact that the storm was a dying one and its path was through comparatively thinly settled country.[2]

Two small dwelling houses were twisted partially from their foundations and a number of barns and sheds also were slightly damaged; wheat fields in the path of the tornado suffered considerable damage.

The approach of the tornado was clearly seen and I was able to make a kodak snapshot of the funnel cloud at a distance of less than a mile from its path; quite a number of others also snapped pictures of it because it was easy to do so. Almost every farm in Kansas is provided with a storm cave or cellar just outside of the dwelling house so that one can be brave and courageous with one foot on the stairway to the cave, quickly snap his or her kodak and then duck to safety. (There were several of us in the cave on the occasion of this storm.)

[1] Credit for bringing the attention of the U. S. Weather Bureau to this tornado belongs to Dr. David White, home secretary, National Academy of Sciences, Washington, D. C., who received a copy of the print reproduced as Figure 1 and brought it to the attention of the bureau. The print was used as a front cover illustration of Science News-Letter of July 19, 1930. Mr. Blackstock has furnished a report on the storm from which the text following has been condensed.—*Ed.*

[2] The cyclonic storm that gave rise to the tornado was centered over southeastern Colorado on the morning of June 2. Its normal northeastward movement was prevented by a strong area of high pressure over Lake Superior and it disappeared during June 2 over Kansas. It may be that the lack of violence displayed by the tornado was in a measure due to the disappearance of the original cyclonic storm as just stated.—*Ed.*